EPA Comments on Excelsior's December 2016 Responses
Excelsior Mining Arizona Gunnison Copper Project
Class III UIC Permit Application

Attachment A[1]

1. Provide a proposal to demonstrate the effectiveness of wellfield operations and conduct model validation and, if necessary, recalibration based on early Stage 1 operations performance, prior to full implementation of commercial-scale ISR operations in Stage 1 and later stages. An EPA review of this early performance and demonstration of effectiveness will be required prior to EPA approval and initiation of full-scale commercial operations. The timeline for this initial demonstration phase should not exceed two years. The proposed intermediate monitoring wells and other well locations for this initial phase should be specified and shown on a map in the updated application. Subsequent monitoring well locations, proposed as ISR operations expand, will be subject to prior EPA approval.

Excelsior should amend and update the application accordingly.

Attachment A-1, Area of Review Method, Groundwater Modeling Report, Aquifer Testing Report

Section 3. Hydrogeologic and Operational Considerations

3.1.1 Site Specific Characteristics, Unsaturated Basin Fill.

2. The Underground Source of Drinking Water (USDW) definition at 40 CFR § 144.3 includes "*or (B) Contains fewer than 10,000 mg/l total dissolved solids; and (2) Which is not an exempted aquifer.*" The basin fill saturation qualifies for that part of the definition, but may not qualify on the basis of "*sufficient quantity to supply a public water system* "if not considered part of the underlying bedrock aquifer. EPA believes there is sufficient evidence to include the basin fill saturated zones as hydraulically connected and part of the bedrock aquifer, and that it should be included within the aquifer exemption as presented in the Excelsior response.

Excelsior should amend and update the application accordingly.

3.1.2 Low Conductivity Sulfide Zone.

[1] References made to specific figures or attachments in these comments refer to materials contained in the original permit application. Information provided in the Excelsior's December 2016 response to the Request for Information are referenced in these comments as the "prior response."

3. EPA agrees that the pump testing data for the sulfide zone indicate a lack of sufficient capacity or quantity of groundwater to supply a public water system well. However, the proximity of the two wells tested to known faults and fractures in the sulfide zone is not known. Hydraulic conductivity (HC) could be much higher in the fault zones, as it is in the oxide zone, and some of the faults are known to transect the oxide-sulfide boundary. One option is that monitoring wells (MWs) could be installed and screened in the sulfide zone in close proximity to the fault zones to better assess the hydraulic connection between the oxide and sulfide zones and to monitor for vertical excursions into the sulfide zone. *Applicant should propose MW locations, subject to EPA approval.*

   Portions of the sulfide zone may qualify as a USDW and require protection from contamination or should be included in the exempted zone. Injection well depths should not penetrate within 40 feet of the sulfide zone as a precaution unless the upper sulfide zone is included in the exemption zone. Excelsior suggested that the upper 200 feet of the sulfide zone could be included in the exempted zones to address this concern and presented more information regarding the close proximity of the two sulfide test wells to faults that transect the oxide-sulfide interface. The absence of a confining layer between the oxide and sulfide zones means that an exchange or mixing of aquifer fluids between the oxide and sulfide zones during ISR operations is likely to occur where injection and recovery wells are situated near a fault zone and the oxide-sulfide interface. The possible exchange or mixing of fluids between the oxide and sulfide zones will be enhanced due to the drawdown of the hydraulic control and recovery wells in the oxide zone and pressure increases with outward flow at the injection wells.

   Excelsior should amend and update the application to include the additional relevant information provided in connection with conference calls with EPA and add a proposal to include the upper 200 feet of the sulfide zone in the aquifer exemption zone.

3.2.1 Hydraulic Gradients

4. Excelsior modeled 1, 2 and 3 percent ratios of excess fluid withdrawals to injection rates and volumes within the wellfield to evaluate the feasibility of these scenarios for operation of the wellfield. However, Excelsior's prior response does not address the minimum extent of over-pumping at the hydraulic control wells necessary to maintain hydraulic control of injected fluids within the proposed wellfield operation. The proposed wellfield design and operation is acceptable with some modification and flexibility for over-pumping recovery wells and/or reducing injection rates in the event of outward movement of ISR fluids and exceedances of conductivity and water level alert levels detected at intermediate monitoring wells (IMWs). The IMWs will be located within the AOR between the downgradient hydraulic control wells and the active mine blocks and upgradient to the active mine blocks. A required minimum over-pumping rate at HC wells should be established during ISR operations which demonstrates maintenance of the minimum required drawdown gradient

between observation wells and hydraulic control of ISR and rinsing fluids. The appropriate over-extraction rates will be determined and monitored on an individual HC well basis, depending on maintenance of the required minimum inward gradient at the observation well pairs.

Excelsior should amend and update the application accordingly.

5. Modeling predictions are subject to errors due to preferential flow paths coincident with the fault plane orientations and other factors that are difficult to model accurately. Injection wells that are near a fault zone oriented in a west-to-east direction could overcome the natural gradient to the east and cause flow to the west if recovery wells are not capturing the entire flow from those wells before exiting the western limits of the wellfield and area of review. We recommend placement of observation well pairs or monitoring wells on the west side of the wellfield to monitor electrical conductance and water levels as suggested by Excelsior in their response and later discussions during conference calls. If the gradient is not sufficiently inward toward the wellfield at any well pair, action would be required to reverse the gradient by means of increasing extraction or decreasing injection rates or increasing HC well pumping to increase drawdown at the wellfield.

   Excelsior should propose /monitoring well locations at the western perimeter of the wellfield at a spacing consistent with the PowerPoint (PPT) presentation viewed during the meeting with Excelsior on February 9. In addition, observation wells should be placed to the south of the westernmost HC well in Figure A-7A in Attachment A-1 of the response document. Final proposed locations for HC and observation wells will be subject to EPA approval. The outer observation wells of all well pairs and intermediate monitoring wells should also be equipped with conductivity sensors to monitor for movement of ISR fluids beyond the wellfield. The PPT presentation viewed during the February 9th meeting should be included in the updated application and the application should be updated to be consistent with that presentation, subject to final EPA approval and permit conditions.

6. The reported natural groundwater flow velocities in the model domain varies widely in the wellfield as illustrated in Figure A-4C. The specific flow velocity attributable to the wellfield area is not provided.

   Excelsior should provide an estimate of average and maximum groundwater flow velocities within the AOR beyond the wellfield perimeter and the estimated travel time from the wellfield to the point of compliance (POC) wells at the eastern AOR boundary.

3.2.2 Injection Flow.

7. The minimum net fluid withdrawal to injection volume ratios and minimum inward hydraulic gradients at all observation well pairs will be determined empirically and based on testing and observation of aquifer response during initial ISR operations and may be adjusted as the wellfield development expands over time, in accordance with permit conditions and subject to EPA review and approval. Initial minimums can be set at one (1) percent for net withdrawals and 0.01 ft/ft for hydraulic gradients pending the evaluation of testing and observation at each well pair in correlation with the withdrawal versus injected volume.

   Excelsior should amend and update the application accordingly.

8. The proposed 30-day rolling average basis for operation of the wellfield and maintaining the balance of fluid injection with recovery well and hydraulic control volumes is acceptable with a demonstration that it is sufficiently protective of USDWs. Initially, the permit will require re-balancing on a 48-hour basis as discussed in greater detail in Comment 59 below until the applicant demonstrates that the 30-day rolling average re-balancing of volumes is as protective as re-balancing on a 48-hour basis during initial Stage 1 ISR operations. The intermediate monitoring and observation well data collected over a sufficient period of time may provide an adequate demonstration during start-up operations.

   Excelsior should propose and submit an operational and monitoring plan for the demonstration and amend the application accordingly.

9. Excelsior believes that a minimum gradient of 0.01 feet/foot (ft/ft) should be sufficient and measurable. As proposed, Excelsior should revise Section 3.2.2 of Attachment A-1 in response to EPA's comments 7, 8, and 9 as presented in your prior response. The 30-day rolling average basis for operation of the wellfield will have to be demonstrated, as discussed above.

   Excelsior should amend and update the application accordingly.

3.2.4 Borehole Abandonment.

10. Excelsior proposes plugging and abandonment of any wells or boreholes within an active mining block that are not suitably constructed to allow for monitoring or possible migration of injected solutions outside of the injection interval. Generally, the plugging and abandonment of wells and boreholes located within active mining blocks and the use of existing wells as intermediate monitoring wells around areas of injection should be adequately protection of USDWs. However, EPA considers the saturated portion of the basin fill and the underlying bedrock aquifer to be one aquifer and a USDW where not exempted, as discussed in Comment 2 above. EPA has concerns about the protection of the substantial USDW downgradient of the project area from migration of undetected contaminants through the basin fill or bedrock zones during ISR operations or rinsing and post-closure periods. EPA is not fully convinced that the bedrock ridge located just to the

east of the wellfield would provide a permanent barrier to ISR fluids not captured by hydraulic control wells as implied in the response to this comment. However, intermediate monitoring wells and POC wells placed downgradient at the AOR perimeter should detect contaminants migrating to the east of ISR operations and trigger corrective actions to address an exceedance of water quality standards.

Excelsior should amend and update the application accordingly

3.2.6 Mechanical Integrity Testing.

11. According to the prior response, Excelsior is willing to conduct Part 2 mechanical integrity testing and will revise the text as presented. However, the response is unclear if all wells would be tested for Part 2 mechanical integrity. If the saturated portion of the basal fill zone is included in the aquifer exemption, as discussed above, Part 1 mechanical integrity tests (MITs) in monitoring, observation, HC, and POC wells would not be required, unless converted to injection wells. Nevertheless, all wells should be pressure tested for casing leaks during construction or conversion to ensure that observation and monitoring wells provide data representative of the injection zone. HC well casings should be pressure tested to ensure that fluids are withdrawn from only the injection zone. See additional discussion and comments on MITs in the comments on Attachment P.

Excelsior should clarify that well casings in all wells will be pressure tested for leaks and Part 2 mechanical integrity testing will be conducted in all wells as described in Section 3.2.6. The application should be amended and updated accordingly.

3.2.7 Rinsing.

12. *a) Please revise the last sentence on page 8 to read: "and all regulated constituents are at or below aquifer water quality standards (AWQSs)* ***and UIC permit water quality standards****. "*

UIC permit water quality standards will refer to primary maximum contaminant levels (MCLs), or pre-mining background concentration levels of regulated constituents, whichever is higher.

Excelsior should amend and update the application accordingly

b) The permit may require that samples be collected from all recovery wells within each mining block after the third step and before approval of closure. As an alternative, the sampling requirement after the third step may be relaxed in subsequent mine blocks if it can be demonstrated that sampling 10 percent of the wells is statistically equivalent to sampling 100 percent of the wells in the rinsing of the initial mine block.

Excelsior should amend and update the application accordingly

b) *Please revise the last sentence in paragraph 2 on page 9 to read: "Analysis will be conducted for APP* ***and UIC permit*** *regulated metals (dissolved), sulfate, TDS, pH, and specific conductivity."*

The applicable UIC permit condition will be written to be consistent with the requested revision to paragraph 2 on page 9 and applicable water quality standards as stated above.

Excelsior should amend and update the application accordingly.

Section 4. Area of Review

4.3 AOR Delineation.

13. The second paragraph states that the proposed western boundary of the AOR is coincident with the property boundary and is *only* 100 feet from the nearest injection wells. The eastward hydraulic gradient is expected to exceed the injection flows to the west, but the gradient and groundwater velocity values are not provided. Moreover, no hydraulic control or observation wells are proposed at the perimeter of the western AOR boundary and wellfield perimeter. If hydraulic containment were lost to the west, that loss would go undetected without HC and observation wells located at the western AOR boundary. The groundwater flow model results show containment at the western boundary, however, due to the heterogeneity and highly faulted structure of the orebody, this modeled outcome cannot be assured during actual ISR operations.

The use of intermediate monitoring wells, as described in the Excelsior PPT presentation of February 9th, addresses these concerns. Refer to Comment 5. Excelsior should identify the hydraulic parameters to be measured when the HC wells are installed and tested. Observation or monitoring wells should be installed at the western perimeter of the wellfield as discussed in the prior response and comments under Comment 5.

The application should be amended and updated accordingly.

14. *Excelsior should clarify the hydraulic parameters noted in the prior response to comment 16 to be measured when the HC wells are installed and tested.*

15. POC wells are to be placed at an appropriate distance to detect movement of regulated constituents during the proposed five-year post-closure monitoring period. Permit conditions may require additional POC wells to be placed at the AOR boundary or closer to the wellfield perimeter if recalibration of the groundwater flow model during ISR operations indicates a need for closer spacing of POC wells. Excelsior proposed the retention of 10 percent of the injection and recovery wells for post-rinse monitoring through the life of the

mine, as presented in the February 9th PPT presentation. This would include monitoring a subset of retained wells annually for five years to verify no rebound has occurred.

Excelsior should clarify the rationale for the proposed POC well spacing at the eastern AOR boundary in response to our concerns about distance of the POC wells from the wellfield. The closure/post-closure strategy described in the February 9 PPT presentation should be added to the updated permit application. Monitoring frequency will be subject to EPA permit conditions and adjustment for monitoring results during rinsing and post-closure monitoring.

Attachment A-2, Groundwater Modeling Report

Groundwater Model

2.5.1 Aquifer Systems.

16. Refer to Comment 2. EPA believes there is sufficient evidence to include the basin fill saturated zones as hydraulically connected to and part of the bedrock aquifer, and that it should be included within the aquifer exemption as presented in the Excelsior response.

Excelsior should amend and update the application as presented in their response.

2.5.2 Groundwater Movement and Boundary Conditions.

17. The application indicated that the recharge calculations are based on the assumption that approximately 3% of available precipitation recharges the aquifer, with the assumption based on information from other similar modeling studies. No references to those other modeling studies were provided in the application.

Excelsior should update the application as presented in the prior response with the citations to (or copies of) those modeling studies that were the basis of the assumptions used in the recharge calculations.

2.5.3 Regional Groundwater Levels and Flow Directions.

18. Additional sensitivity analysis may be necessary if the JCM supply wells are activated for production of make-up water. The basin fill saturation at the Gunnison site from the basin fill aquifer at the JCM supply well locations may be hydraulically connected in the bedrock portion of the aquifer if not the basin fill aquifer, which we consider to be in hydraulic communication with the bedrock aquifer. Additional observation or monitoring wells could also be placed to the north of the wellfield to monitor and detect any loss of containment in the AOR as a result of activities at the JCM wells.

4.4 Hydraulic parameters.

4.4.1 Hydraulic Conductivity

19. The vertical hydraulic conductivity values used in the model should be re-calibrated to ISR operations performance as operational data are collected and evaluated in the initial stage. Refer to Comment 1.

4.4.2 Storage values.

20. The range of porosity values for the sensitivity analyses in the model predictions should also reflect the distribution of the porosity values in the formation. The 50% reduction in porosity might not be sufficient to incorporate the expected porosity values in the site. Furthermore, Figures 42A and 42C in the prior response document show there is a slight excursion of the particles out of the boundary in the south and west sections of the wellfield which coincides with the AOR boundary. If a combination of conditions is selected that would result in the potential loss of hydraulic control (hydraulic conductivity values in the fault zone and other zones of the model and porosity values), it is possible that this excursion could extend further outside the AOR. Therefore, additional monitoring wells should be placed to the west of the wellfield for detection of loss of containment in or excursions from the AOR. Later during ISR operations, if monitoring and observation well data indicate a loss of hydraulic containment or excursion of ISR fluids beyond the proposed AOR, the AOR could be expanded at the southern and western boundary. The proposed intermediate monitoring wells discussed in the conference calls with Excelsior should provide protection from excursions to the south and west of the wellfield.

Excelsior should amend and update the application in Section 4.9.1 as presented in the response to sensitivity analysis for porosity variations and the above discussion.

Model Predictions

5.1 Hydraulic Control Simulation.

21. The simulated time for particles to reach the POC wells 2, 3, 4, and 5 at the AOR boundary is exceeds 20 years. If an excursion occurs beyond the wellfield to the east and north in the post-rinsing period of five years, it would not be detected at the POC wells. Excelsior indicated that the HC and observation wells would be retained during the five-year post-rinsing period during conference call discussion on February 9th. If the HC and observation wells at the boundary of the wellfield are retained for post-rinsing monitoring, excursions could be detected within the five-year post rinsing window and reversed.

Figure 64 should be revised to show the AOR boundary. Excelsior should clarify and add the commitment to retain the HC and observation wells during the post-rinsing period and

propose a monitoring plan and schedule for the observation wells. The related conference call discussions should be documented in the updated permit application.

5.1.2 Hydraulic Control Wells.

22. The proposed intermediate monitoring wells should detect excursions from active mining areas that the modeling fails to predict and the limited number of HC or observation wells fail to detect in the early years of ISR operations, which reduces the need for full activation of 19 HC and observation wells in the early years. *Activation of site-specific HC wells should be dependent on intermediate monitoring well data.*

5.1.3 Particle Tracking.

23. The application indicated that because of the slow movement of particles across the mining area, particles are first released six years after mining starts. Due to faulting and fracturing in site geology, it is possible that ISR fluid could move faster through fractures (secondary permeability features) in some parts of the site.

Excelsior should amend and update the application in Section 5.1.3 as presented in your justification for particle release time given possible fracture flow in places in the prior response to this comment.

5.2.2 Capture Analysis.

24. Figures 57, 58, and 59 in Attachment A-2 of the application show some particles leaving the wellfield area and possibly leaving the AOR on the west side of the site. Due to uncertainties, additional monitoring wells should be placed to the west of the wellfield for detection of possible excursions or loss of containment in the AOR. Excelsior proposed the addition of intermediate and other monitoring wells west of the active mining blocks during the February 9th conference call with EPA with PPT illustrations of the well locations in the wellfield.

Excelsior should document those proposals and illustrations in the updated permit application.

Table 5, Well Information for Project Area.

25. *Please discuss the purpose of the many Env-Monitor wells or piezometers listed on this table. Also, please identify the zone(s) in which each well is open: basin fill, oxide bedrock, sulfide bedrock, or another zone/aquifer.*

The purpose of the Env-Monitor wells or piezometers listed in Table 5 is not discussed in the prior response as requested.

Excelsior should provide the requested information.

Figure 16, Comparison of Fracture Intensity to Hydraulic Conductivity Data.

26. R^2 (R squared) presenting the goodness of the fit was added to the revised Figure 16 as requested. *The figure should replace the original figure in the application.*

Figures 48 to 56.

27. *Based on the prior response, the revised Figures 48 to 56 should replace the original figures in the application.*

Attachment B, Maps of Well/Area and Area of Review

28. The revised Table B-1 referenced in the response document is not provided in the paper copy or CD of the response document.

    Excelsior should provide the revised Table B-1.

29. The POC well locations have been moved to inside of the proposed AOR and aquifer exemption boundary as requested. Intermediate monitoring wells are proposed around and between the mine block and HC well locations as discussed in the response to comment 10.

    The revised Figures H-2 and P-1 should replace the original figures in the application and the Excelsior response should be documented in the updated application.

30. Permit conditions may require that the AOR be expanded at the southern and western boundary later during ISR operations if monitoring and observation well data indicate a loss of hydraulic containment and excursion of ISR fluids beyond the proposed AOR. The EPA aquifer exemption guidance document includes a recommendation for a buffer zone. Intermediate monitoring and observation wells should provide early detection of an excursion before it reaches the AOR boundary. Refer to Comment 5 for more discussion of this issue.

Attachment C, Corrective Action Plan and Well Data

1. Introduction

31. The basin fill saturated zones should be included in the exempted portion of the bedrock aquifer as described in Comment 2.

    Excelsior should amend and update the application accordingly

2. Wells within the Area of Review

32. Table C-1. The record of construction, completion, and status all wells are not provided in the revised Table C of the prior response or referenced elsewhere in the application.

Excelsior should amend and update the application accordingly.

Attachment D Maps and Cross Sections of USDWs

1. Underground Source of Drinking Water

33. Monitoring wells may be required in the sulfide zone as described above. The absence of a confining layer between the oxide and sulfide zones means that an exchange or mixing of aquifer fluids between the oxide and sulfide zones during ISR operations is likely to occur where injection and recovery wells are situated near a fault zone and the oxide-sulfide interface. The exchange or mixing of the sulfide zone fluids with oxide zone fluids will be enhanced due to the drawdown of the hydraulic control wells in the oxide zone. Refer to Comment 3 for more discussion of this issue.

Excelsior should amend and update the application to include the additional relevant information provided in connection with conference calls with EPA and add a proposal to include the upper 200 feet of the sulfide zone in the aquifer exemption zone. Additional monitoring wells in the sulfide zone near the fault zones may not be required if the upper 200 feet of the sulfide zone is exempted.

Figures D-3, D-4, and D-5, Geologic Cross Sections

34. *Figure D-5 in the prior response should be revised to illustrate the presence of the USDW/area of exemption in the Quartz Monzonite zone.*

Attachment H, Operating Data

2. Description of Operations.

2.1 Process Description

35. Figures H-1 and H-2 in the prior response were revised as requested except for addition of the additional HC, observation, and POC wells in Figure H-2 as discussed above. Refer to Comment 5 and other related comments for more information.

The use of intermediate monitoring wells, as described in the Excelsior presentation of February 9th, addresses these concerns. The relevant discussion and figures included in the PPT presentation should be added to the application.

2.2 Injection Rates

36. As discussed in Comments 8 and 9 above, the permit will require re-balancing on a 48-hour basis unless the applicant demonstrates that the 30-day rolling average re-balancing of volumes is as protective as re-balancing on a 48-hour basis during initial Stage 1 ISR operations. The intermediate monitoring and observation well data, collected over a sufficient period of time, may provide an adequate demonstration during start-up operations.

    Excelsior should propose and submit an operational and monitoring plan for the demonstration and amend the application accordingly. The full response to the comment should be added to Section 2.2 in the permit application, including the table titled "Estimated Average Injection Rates by Year."

37. *The revised application should include a proposed minimum net extraction to injection ratio or percentage within wellfields as a means to maintain hydraulic control of ISR fluids in addition to pumping from the HC wells. Please design the ISR operations and groundwater model to provide and simulate containment of ISR fluids to the wellfield as it expands during the life of the project, not merely to the ultimate wellfield planned for year 21.*

    The proposed intermediate monitoring wells and additional observation wells should suffice for monitoring and maintaining containment of individual mine block fluids and detection of excursions.

    The full response to this comment should be added to the application.

38. As discussed in previous comments, EPA has concerns regarding the 30-day rolling average basis used for maintenance of the required ratio of injection to extraction volumes. Hydraulic control and containment of ISR fluids is most effective on a daily basis to prevent movement of ISR fluids out of the exempted zone in unplugged wells and boreholes located within the AOR and beyond the aquifer exemption boundary. The permit will require re-balancing on a 48-hour basis unless the applicant demonstrates that the 30-day rolling average re-balancing of volumes is as protective as re-balancing on a 48-hour basis during initial Stage 1 ISR operations. The intermediate monitoring and observation well data, collected over a sufficient period of time, may provide an adequate demonstration during start-up operations.

    The applicant should propose and submit an operational and monitoring plan for the demonstration and amend the application accordingly.

3. Injection Pressure

39. The methods used to estimate the fracture pressure are useful but leave some doubts about the accuracy of the results. A gradient of 0.75 pounds per square inch per foot (psi/ft) is acceptable as an initial limitation for injection pressure, but will require confirmation by step-rate testing in a representative number of injection wells in the wellfield as a permit condition.

The revised application should modify your description, accordingly, in Attachment H and I under Fracture Pressure. Permit conditions will require continuous monitoring and daily recording of injection pressures.

4. Nature of Annulus Fluid

40. Annulus fluid refers to the fluid in the annulus of injection wells with packers installed, as in Figure M-3 in Attachment M. The prior response is somewhat inconsistent with the discussion of annulus fluids.

Excelsior should clarify why corrosion resistant fluids would not be placed in the annulus of wells constructed with steel casing and packers.

4.1 The Evolution of the Process Solution Chemistry during Mine Operations

41. "EPA water quality standards" is the correct terminology. It means primary MCLs or pre-mining background concentrations, whichever is higher. Groundwater must be restored to background levels if greater than primary MCLs.

Excelsior should amend and update the application accordingly.

Attachment I, Formation Testing Program

4. Chemical Characteristics of Formation Fluids

42. Reference is made to the Arizona DEQ aquifer water quality standards (AWQS) throughout this section, but not to federal MCLs for drinking water quality.

The revised application should reference federal MCLs wherever reference to AWQS is provided and state the MCL when it differs from the AWQS stated in the discussion of a particular constituent. Excelsior should amend and update the application as stated in the prior response.

4.5 Groundwater Quality in the Vicinity of the Project

43. The water quality data for the Johnson Camp Mine (JCM) POC wells will be considered for its historical data and the relatively close proximity to the Gunnison site.

Please provide the requested data in the UIC application and the location of the JCM POC wells on Figure I-7, Potentiometric Surface Map.

Attachment L, Construction Procedures

3. Logging Procedures

3.2 Geophysical Logging

44. *Excelsior should clarify why electrical logs are omitted in the prior response. E-logs should be run in open hole from total depth to surface casing. Include the reason why sonic logs are preferable to density logs to evaluate porosity. Please clarify the statement: "Geophysical logging will not be conducted prior to installing casing." All logs should be run from total depth to surface casing depth.*

Attachment M, Construction Details

45. *Excelsior should be more explicit in describing under what circumstances PVC casing would be installed.*

Attachment N, Changes in Injected Fluid

46. *As discussed during conference calls with EPA, Excelsior should amend and update the application to add a proposal to include the upper 200 feet of the sulfide zone in the aquifer exemption zone.*

47. *The saturated basin fill intervals should be included in the aquifer exemption for the bedrock aquifer, and the application should be revised accordingly, as stated in previous comments.*

Revised Figure I-2 should be added to the application.

3.3 Hydraulic Parameters

3.3.4 Porosity

48. In the prior response, Excelsior provides an extensive discussion of the data collection and evaluation for development of the structural and hydrogeological models of the orebody. However, the core analysis reports were not provided as requested.

Excelsior should justify the omission of those reports or provide the reports in the response. The figures and added text in Section 3, Data Collection and Evaluation, should be added to update the application.

6. Direction of Movement of Injected Fluid

49. The prior response did not address the issue of ISR fluids recovered in the hydraulic control wells and the reduction of PLS fluids produced in the recovery wells resulting from the proposed ISR operation. However, the addition of intermediate monitoring wells should

allow for early detection of ISR fluids escaping from the mine blocks and trigger actions to reverse those excursions by adjustments of injection/withdrawal rates in the mine blocks.

Excelsior should discuss the disposition of ISR fluids recovered in the HC wells and the ramifications to the feasibility of the project.

Attachment O, Plans for Well Failures

2. Contingency Plan Elements

2.1 Loss of Hydraulic Control

50. Permit conditions will require maintenance of over-extraction volumes on a daily basis, or a demonstration that the 30-day rolling average is as effective as daily re-balancing as discussed in other related comments.

Please revise the application accordingly.

2.2 Well Failures

2.2.1 Mechanical Integrity:

51. The requirements for mechanical integrity testing described at §146.33(b) are *minimum* requirements. EPA requires a five-year frequency for all Class III injection wells and the permit will include that provision as a requirement.

Excelsior should amend and update the application accordingly.

Attachment P, Monitoring Program

2. Monitoring

2.1 Injected Fluids

52. *Radium and uranium would be monitored on an annual basis rather than monthly as proposed for the other constituents.*

Please clarify the basis for the less frequent monitoring requirement for radionuclides.

2.3 Mechanical Integrity

53. All wells should be tested for casing leaks and mechanical integrity Part 2 to ensure isolation of the injection zone and containment of other formation fluids.

Excelsior should clarify that well casings in all wells will be pressure tested for leaks and Part 2 mechanical integrity testing will be conducted in all wells as described in Comment 11. Excelsior should amend and update the application accordingly.

2.3.1 Part 1 Mechanical Integrity Requirement

54. *As noted above, EPA will require Part 1 mechanical Integrity testing in Class III injection wells at least once every five years until a well is plugged and abandoned in accordance with UIC permit conditions Excelsior should revise this section accordingly.*

Excelsior should amend and update the application accordingly.

2.5 Groundwater Monitoring

2.5.1 Monitoring Locations:

55. *Please include the schedule for POC installation in Attachment P of the UIC permit application. The POC wells should be located within the AOR boundary, rather than just outside the AOR and aquifer exemption boundary, to confirm that there is no migration of contaminants into the USDW located beyond the aquifer exemption boundary. Please revise Section 2.5 in the permit application in accordance with these requirements.*

2.5.2 Monitoring Parameters:

56. *The revised application should clarify that AQLs will be established based on federal MCLs. Excelsior should amend and update the application as presented in the prior response.*

2.6. Hydraulic Control Monitoring

2.6.1 Fluid Levels:

57. The proposed minimum gradient of 0.01 ft/ft is acceptable as an initial gradient but may be increased depending on the statistical variation of water level data at each observation well pair.

Excelsior should amend and update the application as presented in the prior response.

2.6.2 Specific Conductance Monitoring:

58. *Excelsior should amend and update the application as presented in the prior response and affirm that conductivity sensors will be installed in the outer observation wells, not the inner observation wells.*

2..6.3 Injection vs. Extraction Volumes:

Table P-1 and Figure P-1, POC, Observation, and Hydraulic Control Well Locations

59. Excelsior proposed the addition of intermediate monitoring wells surrounding and west of the wellfield a discussed in their prior response to the comment and presented during the February 9th conference call with EPA and ADEQ. Placement of additional POC wells may be included as a permit condition and may be required if model updates and monitor well data indicate a need for them.

Excelsior should add the relevant discussion and figures included in the PPT presentation during the conference call on February 9th.

Attachment Q-1, Plugging and Abandonment Plan

2. Licensure and Permitting

2.2 Abandonment Notification and Authorization

60. The Plugging and Abandonment Plan forms 7520-14 for each type of well in the prior response show the well number as "Hydraulic Control Wells" and the casing sizes are inconsistent with that shown on schematic diagrams for each well type except the small diameter HC and injection/recovery wells (6.1 inch). Also, the schematics include a note stating that casing and cement will be removed to 2 feet below grade and covered with fill material. However, the schematics show the casing intact and the 7520-14 forms state that casing will be left in the wells.

Please clarify those inconsistencies. The 7520-14 forms should be signed and dated by a company officer.

Attachment Q-2, ADWR Well Abandonment Handbook and Example ADWR Notice of Intent to Abandon Form.

61. "Restoration" is the terminology used by EPA for cleanup and monitoring of the aquifer after ISR operations are completed and before closure is approved. Restoration standards are primary MCLs or pre-mining background (ambient) concentrations, whichever are higher. Samples will be collected from all of the recovery wells after the third step of rinsing operations, rather than just 10 percent. As an alternative, sampling requirements after the third step may be relaxed in subsequent mine blocks if it can be demonstrated that sampling 10 percent of the wells is statistically equivalent to sampling 100 percent of the wells in the rinsing of the initial mine block as discussed in Comment 12b. The wellfield closure and rinsing plan may require more than five pore volumes to achieve regulatory limits of water quality standards. The results of the proposed rinsing plan will be reviewed and amended if necessary to achieve and maintain those standards.

Excelsior should amend and update the application in accordance with EPA comments. In addition, Excelsior should provide a post-closure monitoring plan.

Attachment R-2, Demonstration of financial Capability

62. *The proposed financial assurance instrument should also state that it will include cover post-*rinsing *monitoring and contingency costs. If a surety bond is provided, Excelsior should also establish a standby trust fund.*

Attachment R-3. Wellfield Closure Costs, Appendix M

Appendix M, Closure of ISR Wellfield

Fixed Closure Costs

63. *The revised Attachment R-3 should replace Attachment R-3 in the original application.*

Variable Closure Costs

64. The revised cost estimate provides for sampling of only 10 percent of the recovery wells after the three steps in the rinsing and restoration operations, which is not responsive to the request to revise the verification sampling cost estimates based on 100 percent of recovery well sampling prior to abandonment and additional rounds of sampling at wells that may require more rinsing in step 3 prior to abandonment of those wells. Refer to Comments 12b and 60 for more information and a discussion of a possible alternative to the proposed sampling plan.
Excelsior should revise the verification sampling plan and cost estimates accordingly.

Table M-9, Stage 1 Cumulative Wellfield Closure Liability by Production Year

65. Post-closure monitoring cost estimates are based on five years of monitoring at three POC wells. Monitoring should be performed at all of the POC wells and possibly for more than five years. The duration of post-closure monitoring may be increased beyond the proposed five years, depending on the monitoring results after five years. The sampling and abandonment costs for the retained wells used for rinsing and post-rinsing monitoring, as proposed in the PPT presentation viewed during the February 9th conference call, should be added to the Attachment R-3, Stage 1 Closure Costs.

The cost estimates and schedules for wellfield rinsing, sampling, closure, post closure monitoring, and abandonment of retained wells should be adjusted in Attachment R-3 accordingly.

Attachment S-1, Aquifer Exemptions

4. Proposed Area of Exemption.

66. The saturated basin fill intervals should be included with the bedrock zone in the proposed aquifer exemption, as suggested by Excelsior in their response. The bedrock sulfide zone would need the installation of monitoring wells in proximity to the near-vertical faults that transect the oxide-sulfide transition zone to ensure that ISR fluids are contained in the oxide zone unless the upper sulfide zone is included in the aquifer exemption zone.

Excelsior should amend the application accordingly and as discussed during recent conference calls with EPA.

Figure S- 9, Area of Exemption

67. Permit conditions may require that the proposed aquifer exemption boundary be expanded at the southern and western boundary later during ISR operations if monitoring and observation well data indicate a loss of hydraulic containment or excursion of ISR fluids beyond the proposed AE boundary. Intermediate monitoring wells located west of the active portions of the wellfield should provide early detection of an excursion before it travels beyond the AE and AOR boundaries.

Excelsior should amend the application to be consistent with the proposed plan for intermediate monitoring well placement presented during the February 9th conference call.